CLAIMS

1. A magneto-resistance device comprising:

an anti-ferromagnetic layer;

a pinned ferromagnetic layer coupled with said anti-ferromagnetic layer such that a direction of spontaneous magnetization of said pinned ferromagnetic layer is fixed;

a non-magnetic tunnel insulating layer coupled with said pinned ferromagnetic layer; and

a free ferromagnetic layer coupled with said tunnel insulating layer and having a reversible free spontaneous magnetization,

wherein said pinned ferromagnetic layer comprises a first composite magnetic layer configured to prevent at least one of elements of said anti-ferromagnetic layer from diffusing into said tunnel insulating layer.

2. The magneto-resistance device according to claim 1, wherein said anti-ferromagnetic layer contains Mn, and

said first composite magnetic layer prevents said Mn from diffusing into said tunnel insulating film.

3. The magneto-resistance device according to claim 1 or 2, wherein said first composite magnetic

layer comprises:

ferromagnetic material that has been not oxidized; and

oxide of a material which is easy to bind with oxygen compared with said ferromagnetic material.

4. The magneto-resistance device according to claim 3, wherein said ferromagnetic material contains Co in as a main component.

5. The magneto-resistance device according to any of claims 1 to 4, wherein said first composite magnetic layer is formed from a region of an amorphous phase as a whole or from a region of said amorphous phase and a region of a crystalline phase.

6. The magneto-resistance device according to claim 5, wherein said crystalline phase region contains a plurality of crystal regions, and

said plurality of crystal regions pass through said first composite magnetic layer into a direction of a thickness of said first composite magnetic layer.

7. The magneto-resistance device according to claim 5 or 6, wherein a composition of said amorphous phase in said first composite magnetic layer is $D_zM_{1-z}O_x$ ($0.6 \leq Z \leq 0.9$, and $X > 0$),

said D is at least one selected from the group consisting of Co, Fe and Ni, and

said M is at least one selected from the group consisting of Ta, Zr, Hf, Nb, and Ce.

8. The magneto-resistance device according to any of claims 1 to 4, wherein said first composite magnetic layer contains a plurality of crystal grains comprising said ferromagnetic material,

said plurality of crystal grains are separated from each other by said oxide, and

a part of said plurality of crystal grains contacts an adjacent one of said plurality of crystal grains.

9. The magneto-resistance device according to claim 8, wherein said oxide comprises oxide of at least an element selected from the group consisting of Al, Si, Mg and Ti.

10. The magneto-resistance device according to any of claims 1 to 4, wherein said first composite magnetic layer contains a plurality of crystal grains comprising said ferromagnetic material, and

said plurality of crystal grains are separated from each other by said oxide and pass through said first composite magnetic layer into a direction of a

thickness of said first composite magnetic layer.

11. The magneto-resistance device according to claim 10, wherein a part of said plurality of crystal grains contacts an adjacent one of said plurality of crystal grains.

12. The magneto-resistance device according to claim 10 or 11, wherein said oxide comprises oxide of at least an element selected from the group consisting of Al, Si, Mg, Ti, Ta, Hf, Zr, Nb and Ce.

13. The magneto-resistance device according to any of claims 8 to 12, wherein a thickness of said oxide is thinner than a grain diameter of each of said plurality of crystal grains.

14. The magneto-resistance device according to claim 13, wherein the thickness of said oxide is equal to or less than 2 nm.

15. The magneto-resistance device according to claim 14, wherein an average grain diameter of said plurality of crystal grains is equal to or less than 10 nm.

16. The magneto-resistance device according to any

of claims 8 to 15, wherein ferromagnetic coupling is kept between said plurality of crystal grains.

17. The magneto-resistance device according to any of claims 1 to 16, wherein said pinned ferromagnetic layer further comprises a first metal ferromagnetic layer and a second metal ferromagnetic layer, and

said first composite magnetic layer is interposed between said first metal ferromagnetic layer and said second metal ferromagnetic layer.

18. The magneto-resistance device according to any of claims 1 to 17, wherein a resistivity of said first composite magnetic layer is in a range of 10 μΩcm to 3000 μΩcm.

19. The magneto-resistance device according to any of claims 1 to 18, wherein said free ferromagnetic layer comprises:

a second composite magnetic layer configured to prevent at least one elements of said free ferromagnetic layer from diffusing into said tunnel insulating layer.

20. The magneto-resistance device according to claim 19, wherein said free ferromagnetic layer contains Ni, and

said second composite magnetic layer prevents said Ni from diffusing into said tunnel insulating film.

21. The magneto-resistance device according to claim 20, wherein said free ferromagnetic layer comprises:

a metal ferromagnetic layer, one of whose boundaries is connected to said tunnel insulating layer and the other of whose boundaries is connected to said second composite magnetic layer; and

a soft magnetic layer containing said Ni and connected to a boundary of said second composite magnetic layer which is an opposite side to said metal ferromagnetic layer.

22. The magneto-resistance device according to claim 1 or 2, wherein said pinned ferromagnetic layer comprises:

a non-magnetic layer; and

two ferromagnetic layers anti-ferromagnetically coupled to each other through said non-magnetic layer.

23. The magneto-resistance device according to claim 19 or 20, wherein said free ferromagnetic layer comprises:

a non-magnetic layer; and

two ferromagnetic layers anti-ferromagnetically coupled through said non-magnetic layer.

24. A magnetic memory comprising:

said magneto-resistance device according to any of claims 1 to 23.

25. A method of manufacturing of a magneto-resistance device, comprising:

forming the anti-ferromagnetic layer containing Mn above a substrate;

forming a pinned ferromagnetic layer with a fixed spontaneous magnetization on said anti-ferromagnetic layer, wherein said pinned ferromagnetic layer comprises a first composite magnetic layer to prevent said Mn from diffusing into a tunnel insulating layer;

forming said non-magnetic tunnel insulating layer on said pinned ferromagnetic layer; and

forming a free ferromagnetic layer with a reversible free spontaneous magnetization on said tunnel insulating layer, and

wherein said first composite magnetic layer is formed to have ferromagnetic material, which has been not oxidized, as a main component and oxide of material which has easiness of binding with oxygen equal to or more than said ferromagnetic material as a

sub component.

26. The method of manufacturing the magneto-resistance device according to claim 25, wherein said forming a pinned ferromagnetic layer comprises:

forming said first composite magnetic layer by carrying out reactive sputtering in a mixed atmosphere of an inactive gas and an oxygen gas by using a target which contains at least one ferromagnetic material selected from the group consisting of Co, Ni and Fe and at least one non-magnetic material selected from the group consisting of Al, Si, the Mg, Ti, Ta, Hf, Zr, Nb and Ce.

27. The method of manufacturing the magneto-resistance device according to claim 26, wherein a ratio of a flow rate of the oxygen to a flow rate of the inactive gas in said reactive sputtering is equal to or less than 0.2.